Southern California Edison

DER Integration Projects

August 18, 2015

SCE's EPIC-1 Portfolio

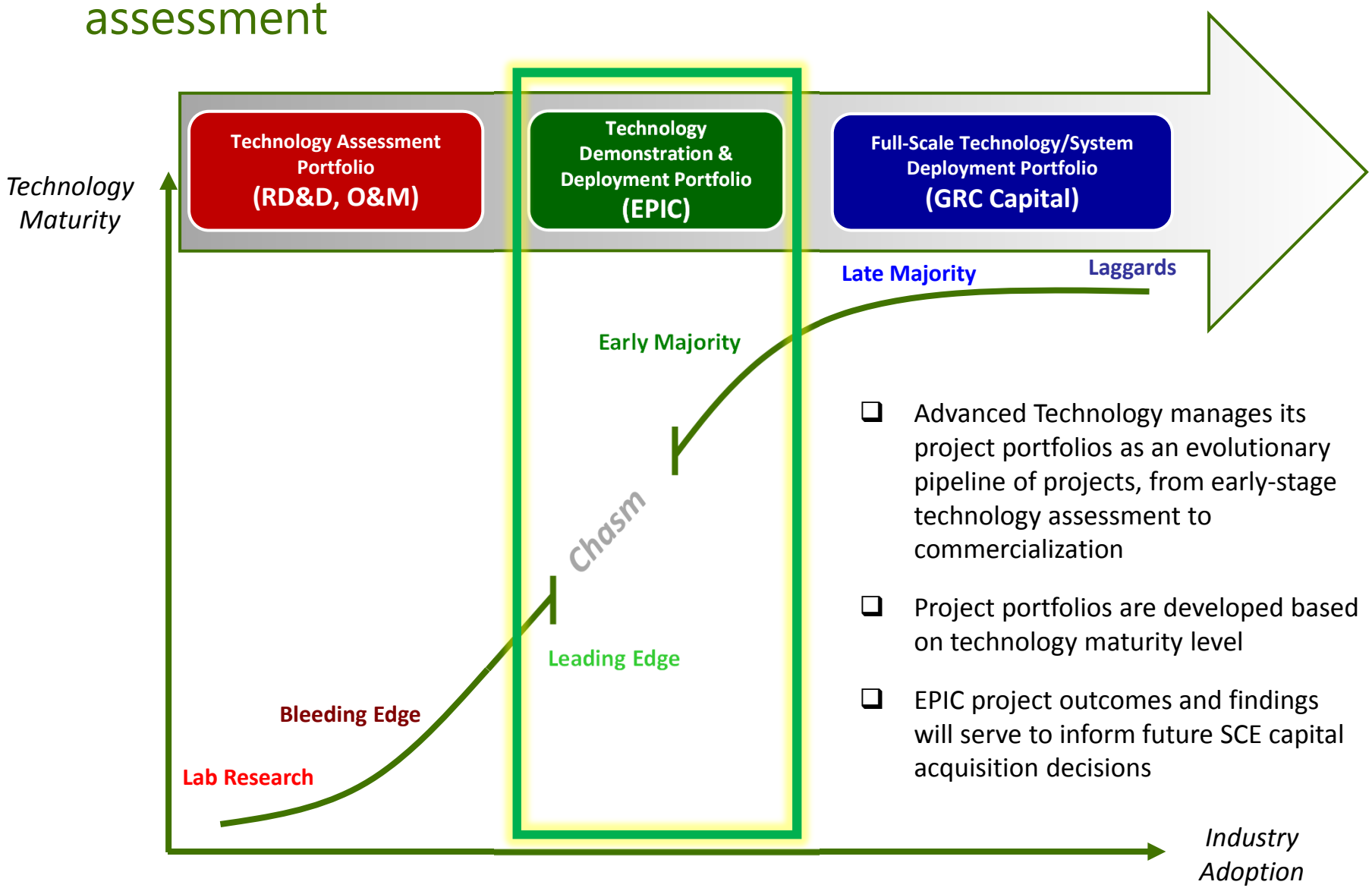
Project Name	Project Status	Project End Date
Integrated Grid Project (IGP)	Execution Phase	2017
Voltage and VAR Control of SCE Transmission System	Execution Phase	2018
Wide-Area Reliability Management & Control	Execution Phase	2017
Dynamic Line Rating Demonstration	Execution Phase	2016
State Estimation Using Phasor Measurement Technologies	Execution Phase	2017
Distribution Planning Tool	Execution Phase	2016
Portable End-to-End Test System	Execution Phase	2016
Distributed Optimized Storage (DOS)	Execution Phase	2017
SA-3 Phase III Demonstration	Execution Phase	2017
Next-Generation Distribution Automation	Execution Phase	2017
Outage Management and Customer Voltage Data Analytics Demonstration	Execution Phase	2015
Enhanced Infrastructure Technology Evaluation	Execution Phase	2017
Beyond the Meter: Customer Device Communications, Unification and Demonstration (Phase II)	Execution Phase	2017
Regulatory Mandates: Submetering Enablement Demonstration	Execution Phase	2016
Cyber-Intrusion Auto-Response and Policy Management System (CAPMS)	Execution Phase	2015

Today's Presentations:

- Integrated Grid Project
- Next-Generation Distribution Automation

*Projects highlighted above support the workshop theme of DER integration

SCE's EPIC investment portfolio focuses on pre-commercial technologies and strategies based on technology maturity assessment



- Advanced Technology manages its project portfolios as an evolutionary pipeline of projects, from early-stage technology assessment to commercialization
- Project portfolios are developed based on technology maturity level
- EPIC project outcomes and findings will serve to inform future SCE capital acquisition decisions

EPIC-2 List of Potential Projects

Renewables and Distributed Energy Resources Integration

- *Dynamic Distribution Circuit Configuration for Storage Siting*
- *Optimized Control of Multiple Storage Systems*
- *Online Security Assessment Tools Demonstration*
- *Bulk System Restoration Under High Renewable Resources Penetration Demonstration*

Grid Modernization and Optimization

- *System Intelligence & Situational Awareness*
- *Next Generation Distribution Automation & Equipment*
- *Fast Dynamic Voltage & Frequency Response*
- *Dynamic Power Conditioner*
- *Series Compensation for Load Flow Control*
- *Special Protection Scheme Platform*
- *Proactive Storm Impact Analysis Demonstration*
- *Advanced Grid Capabilities Using Smart Meter Data*
- *Versatile Plug-in Auxiliary Power System (VAPS)*

Customer Focused Products and Services

- *Regulatory Mandates: Submetering Enablement Demonstration – Phase 2*
- *Integration of Big Data for Advanced Automated Customer Load Management*
- *DC Fast Charging Demonstration*
- *Energy Savings Model Demonstration Using Smart Meter Data*

Cross-Cutting / Foundational Strategies & Technologies

- *Regional Grid Optimization Demonstration*
- *CAISO Operations & Utility Grid Coordination*
- *Microgrid for Enhanced Grid Reliability & Security*

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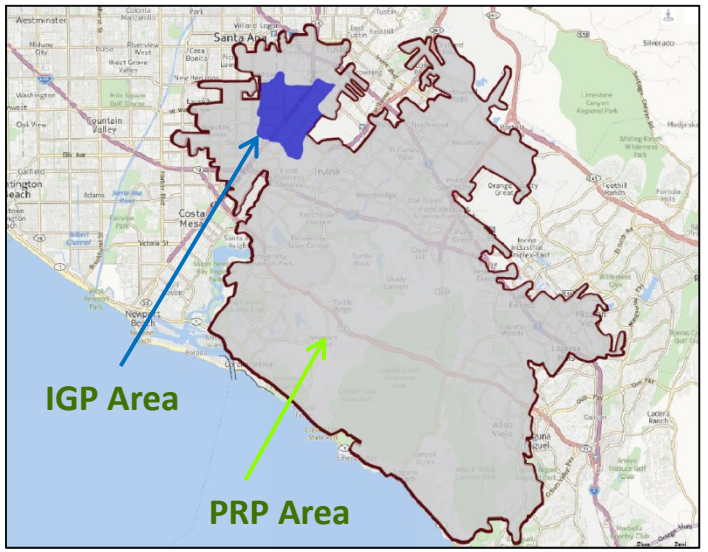
Integrated Grid Project

Presenter: Robert Sherick

Principal Manager, Power System Technologies

Objectives of the IGP

- Facilitate high penetration of DERs by demonstrating next generation grid infrastructure
- Demonstrate controls to manage, operate, and optimize DERs
- Demonstrate ability to optimally operate an integrated distribution system to provide safe, reliable, affordable service
- Obtain results to help determine value of DERs



IGP Focus Areas on DER Integration

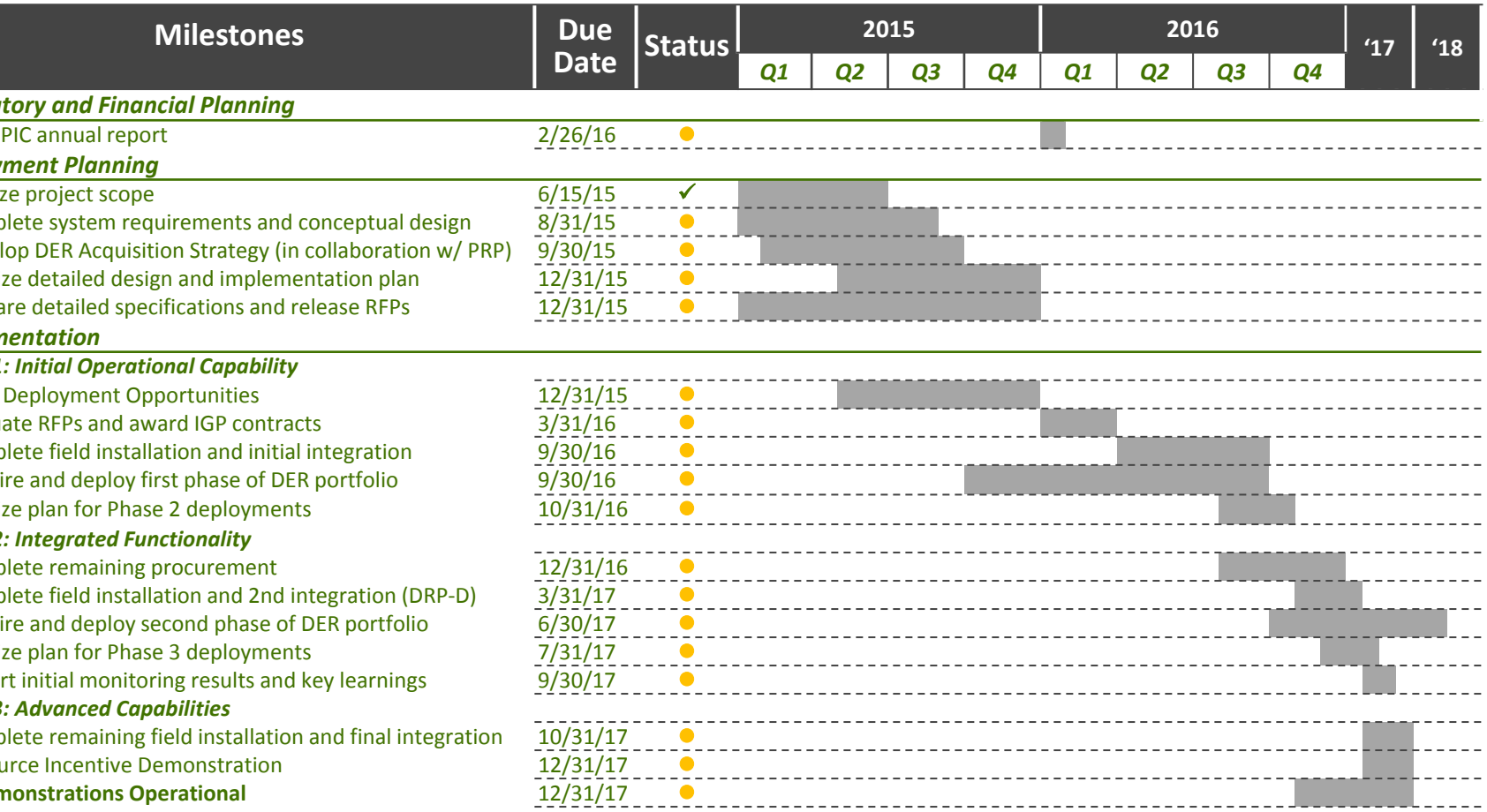
- Implement:
  - Advanced communications and cyber-security
  - Increased circuit monitoring and control
  - Communication to DERs (PV, storage and DR)
  - Integrated controls
- Benefits:
  - Improve Operator's visibility of DERS
  - Manage circuit loading
  - Improve circuit voltage
  - Improve reliability
  - Reduce circuit losses
  - Facilitate higher adoption of DERs

IGP Subprojects

Advanced Substation and Circuit Automation SP 1	Volt/VAR Optimization with DER Participation SP 2	Power Flow Optimization with DER Participation SP 3	High Penetration DER Demonstration (Demo D) SP 4
Resource Incentives SP 5	Field Area Network for Distribution Applications SP 6	Advanced Cyber Security Detection and Integration SP 7	Integration and Messaging SP 8

Implementation Plan

Milestones	Due Date	Status
Regulatory and Financial Planning		
1. File EPIC annual report	2/26/16	●
Deployment Planning		
1. Finalize project scope	6/15/15	✓
2. Complete system requirements and conceptual design	8/31/15	●
3. Develop DER Acquisition Strategy (in collaboration w/ PRP)	9/30/15	●
4. Finalize detailed design and implementation plan	12/31/15	●
5. Prepare detailed specifications and release RFPs	12/31/15	●
Implementation		
Phase 1: Initial Operational Capability		
1. Early Deployment Opportunities	12/31/15	●
2. Evaluate RFPs and award IGP contracts	3/31/16	●
3. Complete field installation and initial integration	9/30/16	●
4. Acquire and deploy first phase of DER portfolio	9/30/16	●
5. Finalize plan for Phase 2 deployments	10/31/16	●
Phase 2: Integrated Functionality		
1. Complete remaining procurement	12/31/16	●
2. Complete field installation and 2nd integration (DRP-D)	3/31/17	●
3. Acquire and deploy second phase of DER portfolio	6/30/17	●
4. Finalize plan for Phase 3 deployments	7/31/17	●
5. Report initial monitoring results and key learnings	9/30/17	●
Phase 3: Advanced Capabilities		
1. Complete remaining field installation and final integration	10/31/17	●
2. Resource Incentive Demonstration	12/31/17	●
IGP Demonstrations Operational	12/31/17	●



✓ Complete ● Ahead ● On Target ● Behind

Q&A

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Next-Generation Distribution Automation

Presenter: Bryan Pham

Sr. Manager, Automation/Communications

Next-Gen Distribution Automation

DRIVERS

- **Current distribution automation technology relies heavily on human intervention, aging technology architecture, and isn't optimized for integrating distributed energy resources (DER).**
- **SCE's current switching scheme can take several minutes to isolate half the load of an affected circuit and doesn't support bi-directional power flow.**
- **No reliable or effective method exists to detect high-impedance faults.**

SCOPE

- **The Next-Generation Distribution Automation project will demonstrate:**
  - **Remote Intelligent Switch (RIS): auto circuit reconfiguration.**
  - **Remote Fault Indicators (RFIs): accurately identify faults quickly.**
  - **Intelligent Fuse: automated branch line protection.**
  - **High Impedance Fault Detection: detect downed energized lines.**

BENEFITS

- **Integrate DER through greater telemetry and programmable logic controls.**
- **Minimize quantity of customer service interruptions.**
- **Quicker fault detection, isolation, and restoration.**
- **Improve communication between automation devices.**
- **Identify an effective and reliable method for detecting high impedances.**

Demonstration Activities to Date

Remote Fault Indicators (RFIs)

- Demonstrated overhead remote fault indicators from three competing suppliers.
- In process of approving one supplier as SCE standard.
- Large deployment planned as part of Grid Modernization.

RFI Sensors

High Impedance Fault Detection

- Completed a proof-of-concept Spread Spectrum Time Domain Reflectometry (SSTDR) technology and distance measurement techniques to detect location of broken non-energized conductor.
- Enhance detector algorithm for maximum number of branching circuits.
- Continued field testing and algorithm refinement
- Developed software to include GIS data in algorithmic analyze of circuit.

Demonstration Activities to Date

Remote Intelligent Switch (RIS)

- **Completed Request for Information (RFI) and Request for Proposal (RFP) with seven (7) potential suppliers.**
- **Awarded RIS scope of work to one supplier.**

RIS Controller

Intelligent Fuse

- **Drafted Request for Proposal (RFP) in order to receive competitive bids from potential suppliers.**

Next Steps

- **Remote Fault Indicators**
  - Complete firmware update, automated deployment process, and standardization for overhead RFI's.
  - Install and demonstrate underground RFI's.
- **High Impedance Fault Detection**
  - Design and build prototype system.
  - Demonstrate solution on energized conductor.
- **Remote Intelligent Switch**
  - Finalize RIS Low-Speed Algorithm (Phase 1).
  - Conduct factory acceptance testing (FAT) for Phase 1 activities.
  - Prepare for site acceptance testing (SAT) and pilot for Phase 1 activities.
- **Intelligent Fuse**
  - Release Request for Proposal (RFP) to suppliers and issue purchase order to winning bidder.

Q&A